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14. ABSTRACT

Equipment was acquired under the Defense University Research Instrumentation Program (DURIP). The equipment, summarized in the report, was utilized to extend the measurement capabilities of diode laser spectroscopy to include carbon monoxide and oxides of nitrogen. These species are of particular importance as indicators of airbreathing propulsion performance and because they are subject to environmental regulation.

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DURIP/Instrumentation Grant Final Technical Report

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1.0 OVERVIEW

This final technical report identifies and describes equipment acquired under AFOSR Grant F49620-99-1-0247 and summarizes the research for which the equipment will be used. The total grant amount including cost sharing was $145,317.00.

2.0 EQUIPMENT ACQUIRED

A description of each item acquired, its manufacturer and cost is given in Table 2.1.

The equipment purchased can be divided into three laser systems and a data acquisition system:

Laser System 1: providing 390 nm radiation;

Laser System 2: providing 306 nm frequency modulated radiation.;

Laser System 3: providing 760 and 1623 nm IR and near IR radiation.

Data Acquisition System.

3.0 RESEARCH ENABLED

Each laser system enables researchers in our group to access wavelengths needed to develop detection schemes for key combustion and atmospheric species.

Laser system 1 provides access to transitions near 390 nm enabling detection of NO_X species. This system has already been applied to the quantitative detection of NO_2 in a shock tube and a static cell. This wavelength regime is also useful for the detection of CH and CN radicals.

Laser system 2 provides the ability to frequency modulate (FM) 306 nm laser radiation. This FM scheme combined with a quieter 532 nm pump laser should offer a 10x improved detection limit for OH radicals. Once this system is functional at 306 nm, we will extend its range of operation to include 225 nm, for the detection of NO.

Laser system 3 takes advantage of VCSEL (Vertical cavity surface emitting diode lasers) and DFB (Distributed feedback) lasers to generate radiation at 760 and 1623 nm. The present scheme should enable quantitative detection of O_2 and C_2H_4 in combustion

flows at multiple locations. These VCSELs have the capability to scan quite widely in wavelength space, and this permits the investigation of the spectral parameters of pressure-broadened lines. Quantitative O_2 measurements have been performed in a cell over a wide range of pressures using this equipment.

The increase in the number of diagnostic wavelengths requires an increase in our data acquisition capacity. This is supplied by the new data acquisition system.

Table 2.1: Equipment Acquired

No.	Description	Manufacturer	Cost ($)
	System 1		
1	Tunable diode laser	PolyTec PI	10,600
	System 2		
2	Solid state pump laser	Coherent Laser Group	51,600
3	Electro-optic modulator	Quantum Technology	22,700
4	Microwave amplifier	Amplifier Research	17,100
5	GHz signal generator	Agilent Technologies	16,300
	System 3a VCSEL Lasers		
6	VCSEL lasers	CSEM CH-8048	2,200
	Supporting optics and accessories including: optical windows, mirrors, mass flow controller, xenon lamp, Si detector	Mueller Optics, New Focus, Horibastec, Photo Technology, Thorlabs Inc.	11,400
	System 3b DFB Lasers		
7	DFB 1624nm lasers	Sumitomo Electric	1,200
	Supporting optics and accessories including: grating, fiber optics, digital camera, multiplexing prism, beam splitter	Edmund Scientific, Oz Optics, Imageologists, Janos Technology, Melles Griot	3,200
	Data Acquisition System		
8	D/A Card	National Instruments	6,700
9	Computer	Dell Computer	2,400
		TOTAL	**$145,400**